



SALMON AO

PEA H3

**Small Complete Missions
of Opportunity**

**in Astrobiology and
Fundamental Space Biology**

**Pre-proposal Conference, 26 Sept. 2008
C. Conley, ASP Program Scientist**



Astrobiology

The study of life in the Universe, focusing on three fundamental questions:

- How does life begin and evolve?
- Does life exist elsewhere in the Universe?
- What is the future for life on Earth and beyond?

<http://astrobiology.arc.nasa.gov/roadmap>



Astrobiology Small Payloads

Goal: Develop and fly small astrobiology payloads to address fundamental astrobiology objectives, using a variety of launch opportunities from small free flyers to suitcase-sized payloads carried on or in the first lunar return vehicle being designed by ESMD.

http://nai.arc.nasa.gov/asp/asp_report.pdf



Objectives:

1. Define high-payoff experiments that can be accommodated in payloads for 1) low-Earth-orbit, 2) high-Earth-orbit or beyond (L1, lunar orbit, etc.), and 3) for the lunar surface. If possible, accommodate sample returns from low-Earth-orbit and beyond.
2. Identify common-carrier capabilities that will accommodate the greatest number of the defined experiments on the greatest variety of launch opportunities.
3. Solicit astrobiology science investigations for initial launch opportunities, focusing on minimizing the time between selection and flight.
4. Fly payloads, accomplish experiments, publish results.
5. Using lessons learned from 1-4, above, repeat as long as science opportunities exist.



ASP Requirements and Constraints

- Technical requirements available at:
<http://tia.arc.nasa.gov/astro-biologysmallpayloads>
- Proposers may also refer to data provided on existing triple cube nanosatellite hardware configurations
- First launch no later than 30 June 2011
- One or more Small Complete Mission investigations may be selected, PI Mission Cost not to exceed \$2M
- Missions of \$1M or less (FY2008 dollars) for all phases of the investigation are a high priority for initial selection
- Multiple proposals may be selected for award if the aggregate cost falls within the total budget available for the Astrobiology Small Payloads opportunity in this PEA

Launch Vehicles



Minotaur I



Falcon 1



Atlas V



Delta IV



Minotaur IV



Taurus



Super Strypi



Launch Vehicle	Provider	Launch Sites
Minotaur I	USAF (Orbital Sciences)	VAFB Wallops FF
Falcon 1*	SpaceX	Kwajalein KSC
Atlas V, Delta IV (EELV)	NASA/ULA USAF	KSC VAFB
Minotaur IV*	USAF (Orbital Sciences)	Kodiak VAFB Other TBD
Taurus	NASA (Orbital Sciences)	KSC VAFB
Super Strypi*	DoE/DoD Univ. Hawaii	PMRF (Kauaii)

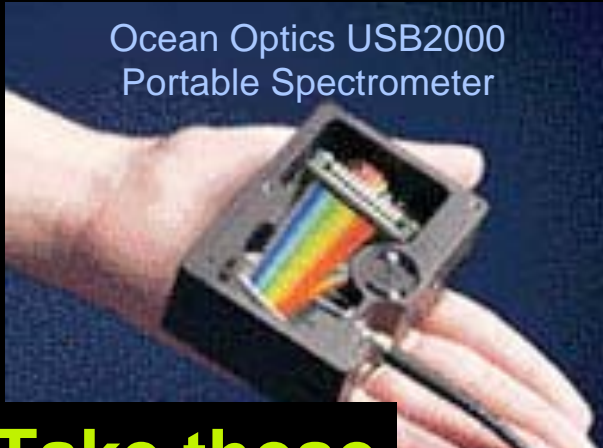
Or something like this:

(NASA/NSF
Antarctic Balloon
Program)



Demonstration Payload: Organism/ORganic Exposure to Orbital Stresses (O/OREOS)

Ocean Optics USB2000
Portable Spectrometer



**Take these
(or similar)**



LOCAD PTS

*developed by private, PP,
ASTID, and ESMD funding*

To do this



EXPOSE

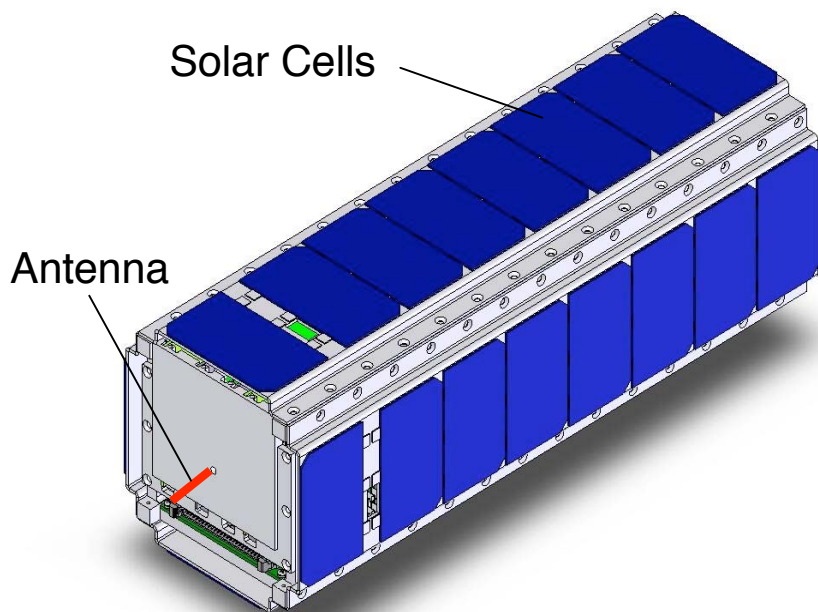
A European Platform for
Exposing Materials to the
Space Environment



Like This! (Conceptual Only)



"Top" Side



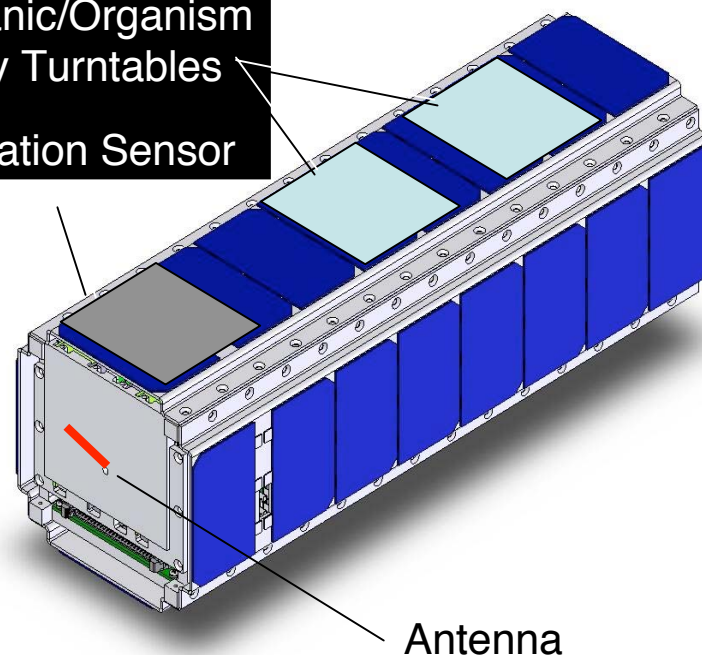
Spacecraft can be naturally tumbling, or may provide micro-pointing capabilities, if available.

Mission length is determined by organic exposure times desired.

Exposure experiments (organics, organisms) to space environment with on-orbit monitoring/ analysis (can vary solar exposure amount, quality, and timing) using internal UV (or other) Raman

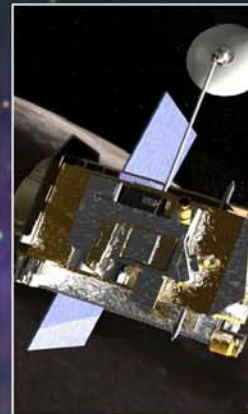
"Bottom" Side

Organic/Organism Array Turntables
Irradiation Sensor





PEA H3: SMALL COMPLETE MISSIONS OF OPPORTUNITY IN ASTROBIOLOGY AND FUNDAMENTAL SPACE BIOLOGY: Fundamental Space Biology Overview



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Advanced Capabilities Division
Exploration Systems Mission Directorate

SMD SALMON Pre-Proposal Conference
September 26, 2008
Holiday Inn Capitol

Goals of Fundamental Space Biology



To elucidate the effects of space environments on life and provide an understanding of life's foundations on Earth and beyond, Fundamental Space Biology strives to expand our knowledge in the following three broad areas:

- **Life at molecular, cellular, system and organism levels.**
- **Interactions within populations and between species.**
- **Life across the life span of an organism and the generations.**

FSB SALMON Opportunity



- A maximum of two individual investigations will be selected.
- The first selected investigation is expected to utilize hardware being developed for the PharmaSat-1.
- The second selected investigation is expected to utilize the PharmaSat-1 flight hardware bus platforms and payload interfaces, but may also utilize other proposed instrument and payload elements.
- In both cases, the specific investigation specimen and protocol will be proposed by the PI in coordination with the hardware developers.
- Both selected **investigations are anticipated to focus on microbe-based studies.**
 - *Proposals utilizing other small organisms will be considered provided they demonstrate the capability to meet the constraints of the solicited opportunity.*

Budget



- Planned launch no later than June 30, 2011.
- Budget cap for complete mission \$1,500K
 - General budget guidelines:
 - PI costs \$250 to 500K
 - Launch \$250K
 - Ground Operations \$150K
 - Mission* \$600K to 1,000K

** Systems engineers, project management, spacecraft, spacecraft integration, final test and integration, etc.*

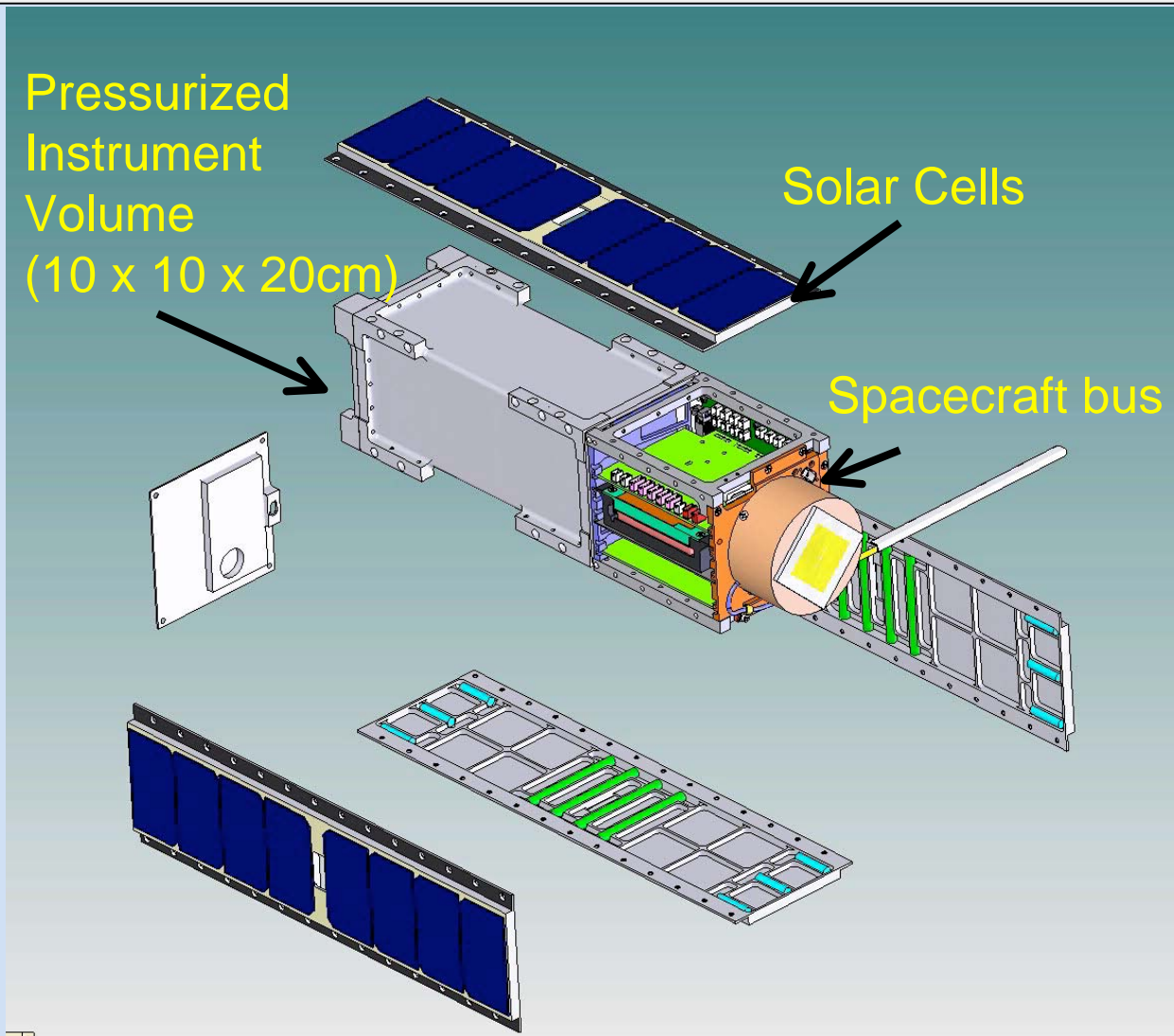
PharmaSat Overview



Pressurized
Instrument
Volume
(10 x 10 x 20cm)

Solar Cells

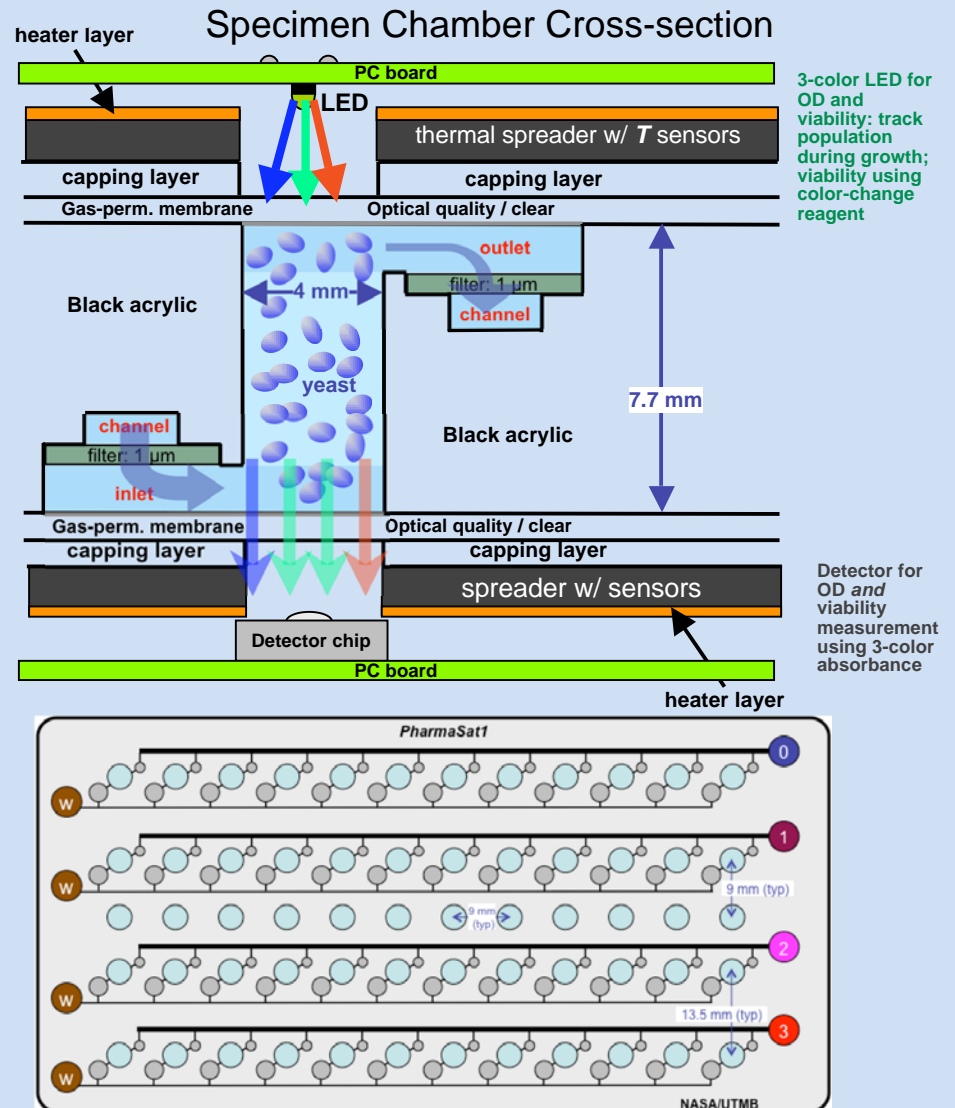
Spacecraft bus



PharmaSat Biology Support




- 48 well card
 - Microplate reader compatible
 - 100µl growing volume/well
- Fluidics (total of ~70ml)
 - Nutrient delivery
 - Reagent delivery (3x)
 - Reference blanks/standards
- Temperature set point between 30° and ~20°C
- 1 atm environment
- <10⁻⁴g microgravity environment
- Environment monitors
 - RH
 - Temperature(s)
 - Radiation sensor (pin diode)
 - Engineering data/health and status





Typical Processing Flow



Notional Timeline

H/W prep (TBD) 

Biology load (~L-48d) 

 Transport to launch site

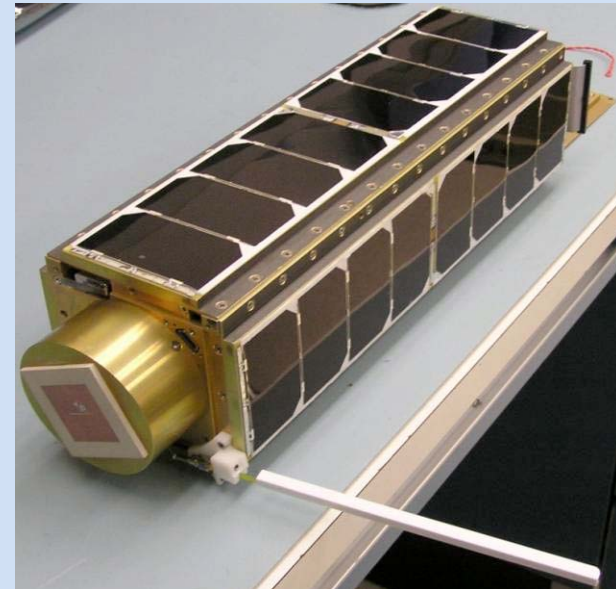
Spacecraft Integration (~L-45d) 



Pad Ops



Launch (L-0)



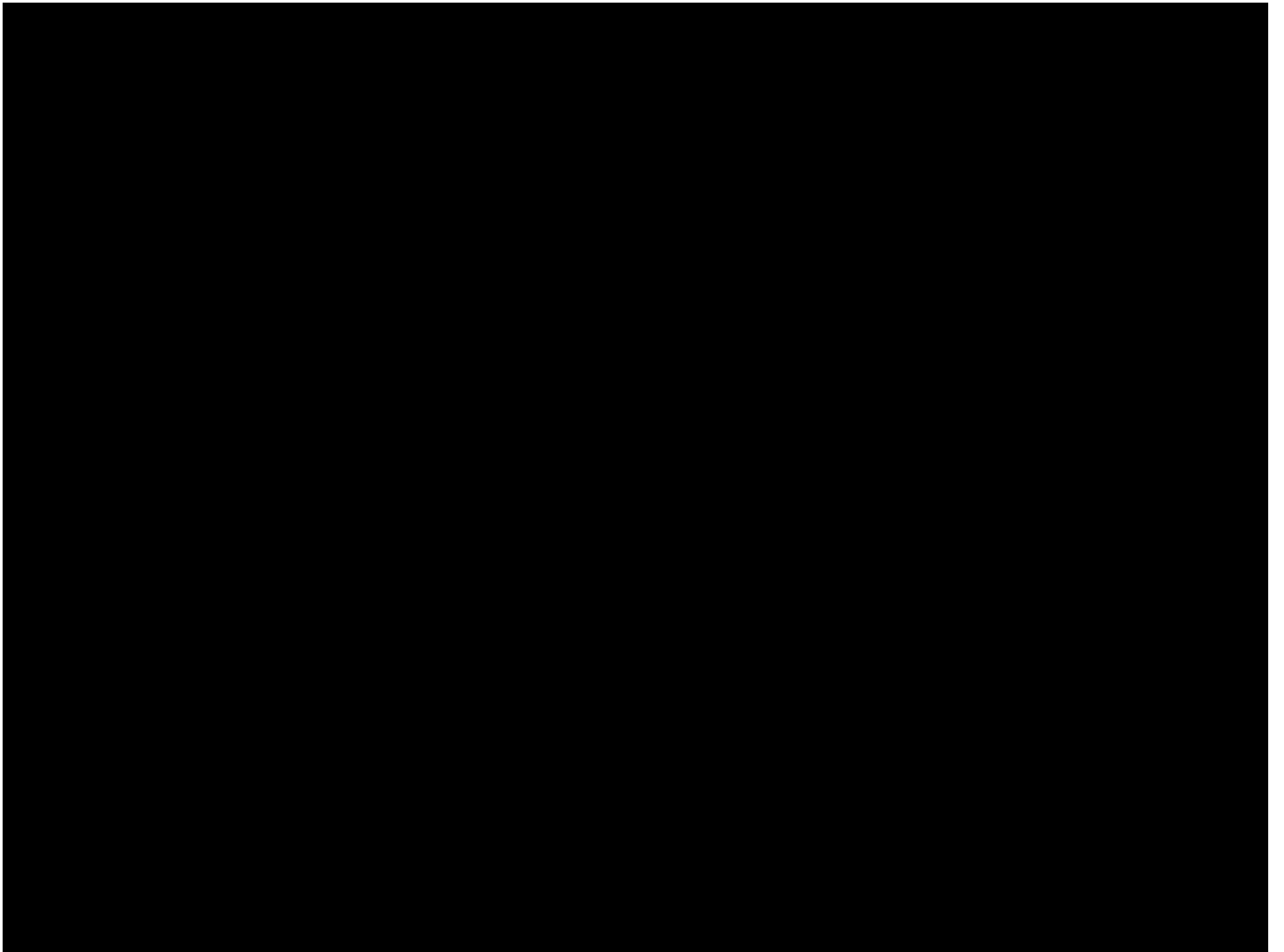
Technical Information



- Proposer's Information Package:
<http://microsatellitefreeflyer.arc.nasa.gov/>
- Announcements and FAQ:
<http://salmon.larc.nasa.gov/index.html> and
<http://nspires.nasaprs.com/external/index.do>
- Interfaces, launch environments and instrument accommodations:
 - Bruce Yost/NASA ARC: bruce.d.yost@nasa.gov
- Collaborations:
 - Elwood Agasid/NASA ARC: elwood.f.agasid@nasa.gov
- Programatic questions:
 - Jacob Cohen/NASA HQ: jacob.cohen-1@nasa.gov

Questions





PPOD (Poly-Picosatellite Orbital Deployer)

